Adriatic Meteorology

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LONG-TERM GOALS

The long-term, capstone goal is understanding air-sea interaction. Special attention is on the nature of the winds, wind stress and curl of the wind stress and the transfer of heat fluxes under unstable conditions in coastal waters.

OBJECTIVES

A major objective is to examine the temporal variations of the winds and wind stress in the cold air over warmer ocean case occurring over the Northern Adriatic during the winter and spring. Since there are no adequate over water measurements, these needed to be made. A first step to untangling the boundary layer processes in this complicated case is to capture the wind variations during cold air outbreaks which are known to have unusually high, short term pulses (~ 15 seconds) that are reported to be twice the mean (10 minute average). The second step is to show what this variation does to the surface stress and heat flux that is lost in longer averages (> minute).

Another major objective is to characterize the mesoscale atmospheric variations over the winter Adriatic sea. Special attention is to the cold air outbreaks, locally called Boras, for which the over water description is wanting. The synoptic scale structure will also be examined as this is essential to grasp the mesoscale.

A final objective is to obtain time series measurements of the synoptic and mesoscale to aide the COAMPS atmospheric numerical modelers in dealing with the mesoscale atmospheric processes.

APPROACH

The basic approach is to make the missing atmospheric measurements necessary to characterize the air over the winter Adriatic. Three different sets of measurements were targeted to meet the goals of this project. The first was in upper air where there were no close operational upper-air stations on the all-important, NE side to characterize the inbound Bora air mass. Fortunately, there is an up-to-date, perfectly-located, sounding station positioned at the Croatian coastal town of Zadar (see following image of the launch of a balloon sounding at Zadar) . This station was set-up but not fully operational. The Croatian Meteorological service was contracted to double their soundings to two a day, the minimum to capture synoptic scale changes. In addition, the Croatian government generously turned

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14. ABSTRACT
The long-term, capstone goal is understanding air-sea interaction. Special attention is on the nature of the winds, wind stress and curl of the wind stress and the transfer of heat fluxes under unstable conditions in coastal waters.

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over to us their once-a-day Zadar soundings between 1 January – 30 June and twice-a-day operational soundings at Zagreb.

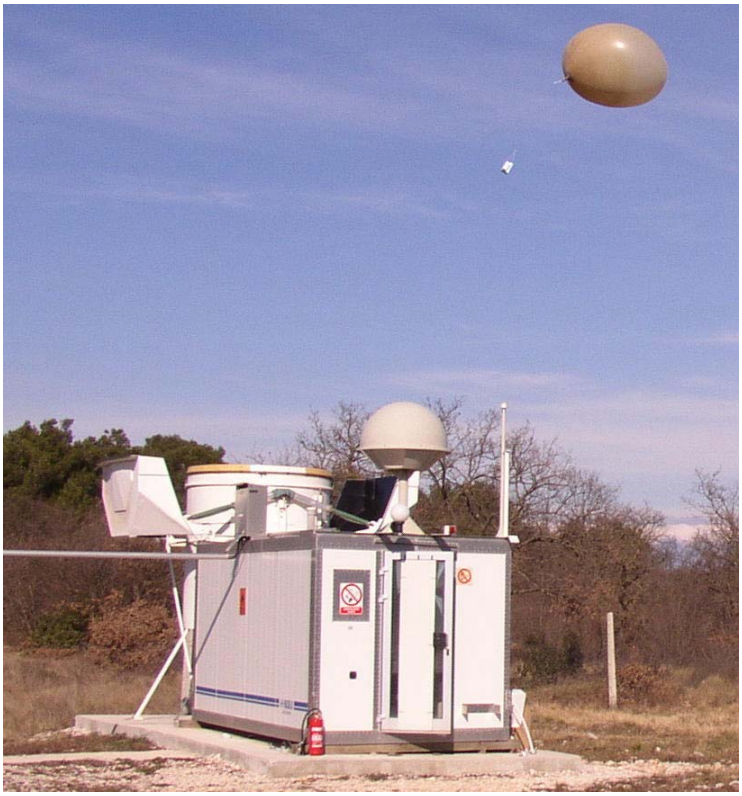

Figure 1. Start of sounding at Zadar, Croatia.

The second approach was to make fixed surface station measurements of winds, temperatures, humidity, pressure, longwave and shortwave radiation to characterize the winds, stress and heat fluxes for the winter and over water. Four automated meteorological stations were placed on four gas platforms that were allowed by the platform operator (See following image of Amelia-B, site of one of the automated meteorological stations). Installation was carried out by Scripps Engineer Douglas Alden in February and retrieved in June 2003.

The third approach was to fill in between the fixed stations with measurements made on two RV KNORR cruises - one in January/February 2003 and one in May/June 2003. Onboard the KNORR were minute averaged, meteorological measurements of winds, pressure, air temperature, sea temperature, short-wave radiation. This project added acoustically sampled winds measured at one-second intervals (to characterize the gusts), as well as long and short wave radiation, humidity (not sampled by the KNORR). Other basic meteorological measurements of air temperature and pressure were made as a back-up. Finally, a laser ceilometer was included to measure the presence of clouds. Initial preparation and installation of the SIO portion of the meteorological equipment on the RV KNORR was done in the end of December 2002 while the ship was docked at Woods Whole by SIO Engineer Douglas Alden and an assistant. The KNORR crew and WHOI support people were extremely helpful, making themselves available during the Christmas Holiday to assist with several large and small items. We are most grateful to the WHOI community to the help and many kindnesses they extended to us and our project during this period.

Automated meteorological station equipment was stored on the RV KNORR in June while it was in Ancona, Italy. SIO Engineer Douglas Alden dismounted the meteorological installations from the RV KNORR stored it on the ship to be transported back to Woods Hole and then shipped back to San Diego.

Figure 2. Italian AGIP gas platform Amelia-B, site of one of four automated meteorological stations.

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WORK COMPLETED

The Croatian Meteorological Service was contracted to double the number of upper air soundings at the Croatian coastal station of Zadar (44.10 N 15.34 E , 79 m/MSL). This was rather straight forward, requiring only a subcontract prepared for SIO system and statement to be Emailed to the Croatians who are direct and responsive to Email. The Zadar station has a modern, GPS based Vaisala sounding system (shown in first image). A sounding was taken at 0000 UTC from 1 January through 31 March, and at 1200 UTC from 10 January through 31 March. The Croatians turned over the 1X day soundings in the first part of January that was beyond the contract requirements. In addition, they provided a digital copy of the Zagreb, 2xday, operational soundings for the same period. The data has been received at SIO and appears to be excellent.

The preparation for the field surface measurements took some effort. A summer 2002 visit was made to AGIP, the Italian national petroleum company that owns the Adriatic gas platforms. Access to the gas platforms required following up with extended discussions over the fall and winter to meet legal, safety, insurance and operational requirements. The result was that three documents were generated, which included, among other things, the specific tools that the Scripps technician was to carry to do the installation. Final formal permission was granted after the Scripps technician was obliged to purchase his air tickets to qualify for the lowest, advance fare rates. An additional unwholesome wrinkle developed when the air-freighted equipment was held up by Italian customs in Milan for more than three weeks, requiring more than a little attention by many different people and calling everybody we could think of. It seems that someone on the Italian end changed the duration of the gear in Italy from "temporary" to "indefinite". The result was that the automated stations were installed more than 3 weeks late. Four automated meteorological stations were installed on four Italian AGIP gas platforms in the NW Adriatic by 7 February and retrieved around 15 June. These recorded the 1-second averages of the winds, 1-minute averages of the air temperature, humidity, pressure, sea surface temperature, long and shortwave radiation. The data is being converted to a format suitable for use on a mainframe computer.

Table 1. SIO Automated Meteorological Station on AGIP Adriatic Gas Platforms

Platform	Latitude	Longitude	Wind Elevation	
Garibaldi C	44 31.878 N	12 30.928 E	36.8 m	edge helio deck
Amelia B	44 24.437 N	12 39.741 E	37.1 m	edge helio deck
Cervia C	44 17.683 N	12 38.349 E	23.2 m	cross platform boom
Azalea B	44 10.028 N	12 43.202 E	29.3 m	cross platform boom

Ship based surface meteorological observations were made from the RV KNORR on the 31 January - 24 February 2003 and the 26May- 15 June 2003 cruses. Unfortunately, the KNORR had a grounding incident leaving Woods Hole requiring repair, delaying the January cruse start until the end of the month, missing a portion of the Bora season. The ship IMET system, maintained by the ship, was on board and operating. Minute averaged measurements were made of the winds, air temperature, sea surface temperature, pressure and long wave radiation along with GPS position. This project placed a sonic anemometer (with 1 second averages to capture gusts), as well as an automate meteorological

station with air temperature , humidity and pressure, long and shortwave radiation. In addition, an upward looking ceilometer measured the cloud height and condition. This data has been processed and the ship motions removed from the wind measurements. However, there is an unresolved problem with the KNORR wind speed and direction.

Clive Dorman went on the 31 January - 24 February 2003 RV KNORR cruise. The object was to watch over the automated meteorological station operation and data collection, and correct system faults should they occur during the crucial Bora season (none did). In addition, this provided an opportunity to observe the Bora conditions and winter meteorology of the Northern Adriatic.

RESULTS

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The first year was focused on data collection. The sounding data was successfully retrieved. The AGIP gas platform data was successfully retrieved from all four stations although the actual collection was delayed for 3 weeks due to a customs problem. The Knorr instruments, both SIO and those on the ship (IMET) worked for both deplyments. However, there is an unresolved problem with the KNORR IMET winds. In addition, a grounding incident delayed the start of the first cruise for 10 days.

IMPACT/APPLICATIONS

Potential future impacts are better understanding of marine boundary layer processes, how stress and heat are exchanged, improvement of atmospheric numerical modeling, and improvement of weather forecasting.

RELATED PROJECTS

J. Doyle/NRL, J. Pullen/NRL : Linking large scale and mesoscale COAMS model studies with surface and upper air measurements to investigate mesoscale structure, stress, curl of the wind stress and heat flux over the Northern Adriatic.

C. Lee/APL, B. Jones/ USC : Heat Flux, surface meteorology significant to Adriatic heat budget, water mass, currents.